Nutritional Assessment and Proximate Analysis of Selected Vegetables from Parachinar Kurram Agency

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Abstract

Four commonly consumed wild vegetable species, *Allium cepa*, *Brassica oleraceae var. capitata*, *Spinacia oleraceae* and *Coriandrum sativum* were subjected to nutritional assessment and proximate analysis. Total protein, fat, carbohydrate, crude fiber, ash, and moisture contents were reported as the percentage composition, using standard methods of Association of Official Analytical Chemists (AOAC). Energy values were calculated for all the species using their nutritional composition. Results showed that moisture and carbohydrates were high for *Brassica oleraceae var. capitata*, ash and crude fiber were high for *Spinacia oleraceae,* proteins were high for *Coriandrum sativum*, and fats and energy values were found high for *Allium cepa*. These vegetables were proved to be ladled with high level of proximate parameters and therefore may be considered as a good source of food.

Key words: Wild vegetable species, proximate analysis, percentage composition, AOAC

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1. Introduction

Food is one of the prime basic needs of humans, for good health, labour productivity, and mental development. Due to high rate of population growth in developing countries, shortage of fertile land and increase of food prices result in problems like hunger and malnutrition. Deficiency of protein is widespread and has been cited as the most common form of malnutrition in the developing world (Pelletier et al., 1995). Since time immemorial, plants have been handled by human societies for food purposes. Today human plant food is based on mainly twelve crops, which contribute more than 85–90 % of the total world's caloric intake. It is also fact that in many parts of the world, the use of wild plants is not negligible (Prescott-Allen and Prescott-Allen 1990; Scherrer et al., 2005; Bussmann et al., 2006; Bussmann and Sharon 2006; Kunwar et al., 2006; Cavender 2006, Pieroni et al., 2007).

Green leafy vegetables are well known for their nutritional importance. They are proved rich sources of protein, ascorbic acid, carotene, folic acid, riboflavin, and minerals like calcium, iron and phosphorus (Kris-Etherton et al., 1988; NRC 1996; Osler et al., 2001; Sheela et al., 2004). Wild edible green plants are commonly found in countries with rather varied climates. Many researchers have shown several wild species of vegetables fit for human consumption. In some modern cultures people consume wild plants as a normal food source, to obtain good amounts of several nutrients as it is widely accepted that leafy green vegetables are significant nutritional sources of minerals (Grau et al., 1989; Kuhnlein, 1990).

Many workers have reported the compositional evaluation and functional properties of various types of edible wild plants in use in the developing countries around the world (Lockeett et al., 2000; Akindahunsi and Salawu, 2005; Edeoga, 2006; Hassan and Umar 2006; Ekop, 2007). In Pakistan, wild vegetables are used as food in both urban and rural areas. The researchers have investigated several wild plants for nutritional composition (Khattak et al., 2006; Imran et al., 2007; Hussain et al., 2009; Jan et al., 2011), but the database of the nutrient and chemical compositions of these plant foods is still incomplete and much work is still needed to be done.

Parachinar region, an arid region, has bestowed with ample natural wealth of plant species. Local people depend in one way or the other on these species for food and medicines. Usually to fulfill the nutritional needs peoples collect various wild vegetable species from the nearby mountainous agriculture fields. The nutritional evaluations of such wild species are very much important to find out any shortcoming in the daily food of the local public. In this study four commonly used wild vegetable species *Allium cepa*, *Brassica oleraceae var. capitata*, *Spinacia oleraceae* and *Coriandrum sativum*, from Parachinar Kurram Agency, Pakistan were analyzed for proximate and nutrient analysis, using standard AOAC methods.

2. Materials and methods

2.1. Collection of samples

The plant materials were collected from Parachinar, Kurram Agency, from July to November 2010. Five samples were collected for every species at different times and each sample was studied in triplicate, thus making a total of 60 samples analyzed. Standard methodology was used for collection of plant samples (Humphry, 1993). Specific samples were obtained with the aid of interpreters and field guides. Genus and species was identified by plant taxonomist, by comparison with herbarium reference materials. The voucher specimen was preserved in Department of Plant Sciences, KUST, Kohat, for future references. The samples were shed dried, pulverized and stored in an airtight container. Details of each plant species, in respect of their scientific, family and local names, part used and status are elaborated in Table 1.

Table 1. Details of wild vegetable species analyzed

Species Name	Family Name	Local Name	Parts Used	Status
Allium cepa	Allliaceae	Peyaz	Bulb	Wild
Brassica oleraceae var.capitata	Brassicaceae	Band gobhi	Leaves	Wild
Spinacia oleraceae	Amaranthaceae	Palak	Leaves	Wild
Coriandrum sativum	Apicaceae	Hara dhanya	Leaves	Wild

2.2. Determination of moisture, ash and crude fiber contents

Moisture was determined by keeping the samples in oven at 100-110 ºC for overnight and then cooling in desiccator. The loss in weight was regarded as a measure of moisture content. For ash content, the samples were heated in muffle furnace at 550 ºC, until white or grayish white ash was obtained. Weight of the ash was noted directly. Crude fibre was measured by treatment of the samples with 1.25% H_2SO_4, 1.25% NaOH and then 1% HNO_3, filtered and washed with hot water after each step. The residue obtained was dried in oven at 130 ºC and ashed at 550 ºC in furnace. The loss in weight on ignition was expressed as content of crude fiber.

2.3. Determination of lipid, protein, carbohydrate and energy contents

Total lipid was extracted from the sample with petroleum ether (60-80 ºC) in a Soxhelt apparatus for about 6-8 h. The residual solvent was evaporated in a preweighed beaker and increase in weight of beaker gave total lipid (AOAC, 2000).

Nitrogen content in the sample was estimated by using micro Kjeldahl method and crude protein was calculated by multiplying the evaluated nitrogen by 6.25. The value of total carbohydrate was given by: 100-(percentage of ash + percentage of total lipid + percentage of protein + percentage of crude fiber) (AOAC, 2000). The calorific value was calculated by multiplying the values of total carbohydrate, lipid and protein by the factors 4, 9 and 4 respectively, taking the sum of the products and expressing the result in kilocalories (Guil-Guerrero et al., 1998).

2.4. Statistical analysis

Data were reported as mean ± standard deviation of triplicate measurements. Significant differences ($p < 0.05$) within means were analyzed by analysis of variance (ANOVA) and Tukey's honestly significant difference (HSD) test in the SPSS Statistics Software Version 20 (IBM, New York, USA).

3. Results and Discussion

The four selected species of wild vegetables from Parachinar, showed variant proportions of proximate and nutritional contents as mentioned in Table 2 and Table 3. The results are discussed in comparison with published literature and biological applications under the following two headings.

3.1. Moisture, ash and crude fiber contents

Moisture in vegetables is a good source of water and is necessary as it is considered that around 20% of the total water consumption must come from food moisture (FNB, 2005). The average moisture content of the four species on both wet and dry bases are liste in table 2. On wet basis the moisture content of the four species, *Allium cepa*, *Brassica oleraceae var. capitata, Spinacia oleraceae* and *Coriandrum sativum* were 87.55 %, 88.48 %, 90.21 % and 83.58 % respectively (Table 2).

Table 2. Moisture, ash and crude fiber contents (%) of the vegetable species analyzed

Species name	Moisture		Ash	Fiber
	(Wet basis)	(Dry basis)		
Allium cepa	87.55 ± 0.02[b]	23.89 ± 0.0[1c]	10.13 ± 0.07[b]	19.53 ± 0.06[b]
Brassica oleraceae var. capitata	88.48 ± 0.02[b]	24.00 ± 0.12[c]	8.21 ± 0.0[a]	10.36 ± 0.01[a]
Spinacia oleraceae	90.21 ± 0.18[c]	14.51 ± 0.02[b]	22.50 ± 0.09[c]	24.08 ± 0.0[1]
Coriandrum sativum	83.58 ± 0.16[a]	10.49 ± 0.05[a]	20.07 ± 0.04[d]	23.30 ± 0.01[c]

[abcd] Values are mean ± standard deviations of three (n = 3) measurements. Different superscript letters within columns are significantly different ($p < 0.05$).

Spinacia oleraceae was having the highest (90.21 %), while *coriandrum sativum* having the lowest moisture contents on wet basis (Fig. 1). The average moisture content holding capacities were found to be dependent on the nature of the plant and environment**.** The moisture content was comparable to other wild edible plants such as *Amanthus viridus, Chenopodium murale, Nastrium officinale* and *Scandex pectin-veneris* with 88.90, 89.50, 90.54 and 81.31 % respectively (Imran et al., 2007).On the other hand moisture contents were very high than *Bupleurum falcatum*, *Valeriana officinalis*, *Forsskalea tenacissima*, and *Lavandula angustifolia* (Adnan et al. 2010).

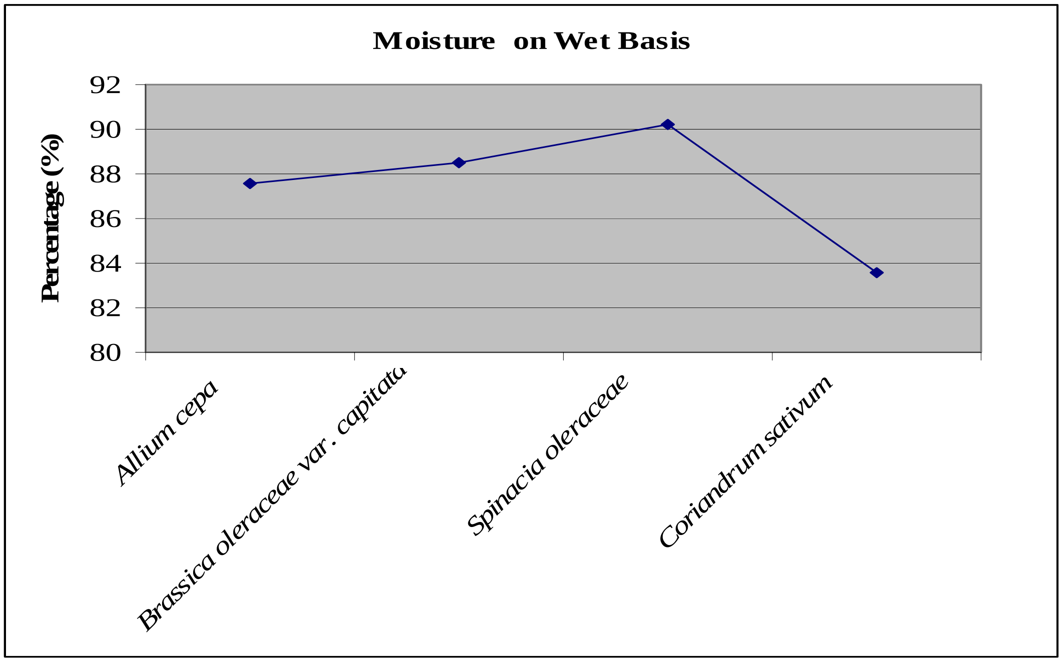

Fig. 1. Moisture content on wet basis.

Looking to the moisture content on dry basis, the descending order of these species was: *Brassica oleraceae var. capitata* > *Allium cepa* > *Spinacia oleraceae* > *Coriandrum sativum.* Thus *Brassica rapa*, was having highest moisture content (25.11%) on dry basis (Fig. 2).

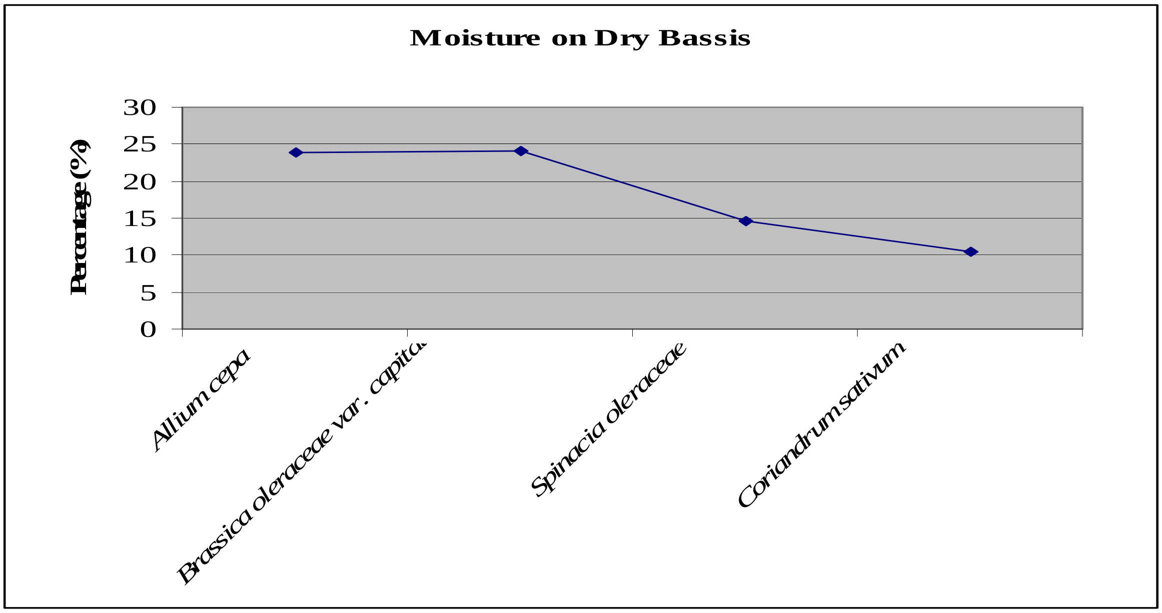

Fig. 2. Moisture content on dry basis.

Like the moisture content, ash is also very important from biochemical point of view. Ash contain all the important nutritional ingredients especially minerals, both micro and macronutrients, which are very important for the normal physiological functions of the body. Ash content of the vegetable species, *Allium cepa*, *Brassica oleraceae var. capitata*, *Spinacia oleraceae* and *Coriandrum sativum* were 10.13%, 8.21%, 22.504% and 20.07% respectively (Table 2). *Spinacia oleraceae* and *Coriandrum sativum*, showed comparatively high contents of ash, indicating that these may the rich sources of nutritionally important elements (Fig. 3). The value obtained was higher compared to 1.8 % reported in sweet potato leaves, and 5 % in *Tribulus territris* leaves, 1.85 % in *Amaranthus viridus* leaves, 2.70 % in *Chenopodium murale* leaves, 1.77 % and 3.10 %, in *Nasturtium officinale* and *Scandex pectenveneris* leaves respectively (Imran et al., 2007).

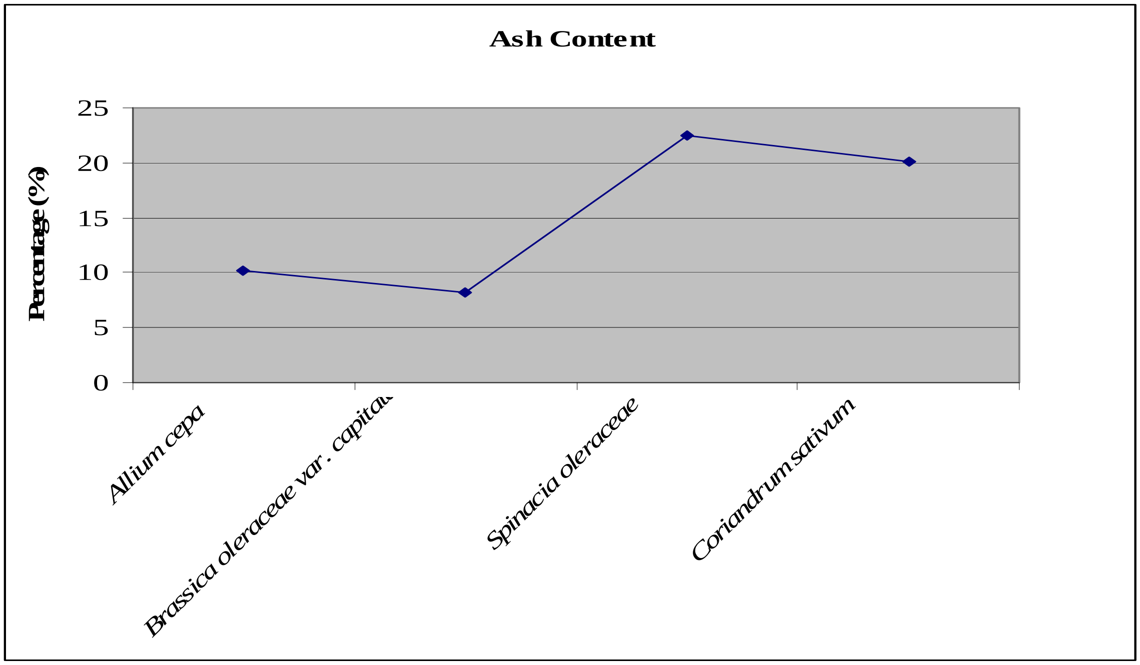

Fig. 3. Ash Content of the wild vegetable species.

The crude fiber content of the analyzed vegetable species is listed in Table 2. Fiber is necessary for the lowering cholesterol level as well as for the smooth intestinal functioning. Crude fiber for the four selected vegetable species, *Allium cepa*, *Brassica oleraceae var. capitata*, *Spinacia oleraceae* and *Coriandrum sativum* were: 19.53%, 10.356%, 24.08% and 23.302% respectively, showing that *Spinacia oleraceae* is the richest source of fiber among these species (Fig. 4). It was higher compared to 7.20 % in sweet potato leaves, 1.93 % in *Amaranthus viridus*, and 3.82 % in *Scandex pectenveneris* leaves (Akindahunsi and Salawu 2005). However fiber content was lower compared to *Melia azadirchta* as determined by Hussain et al 2010.

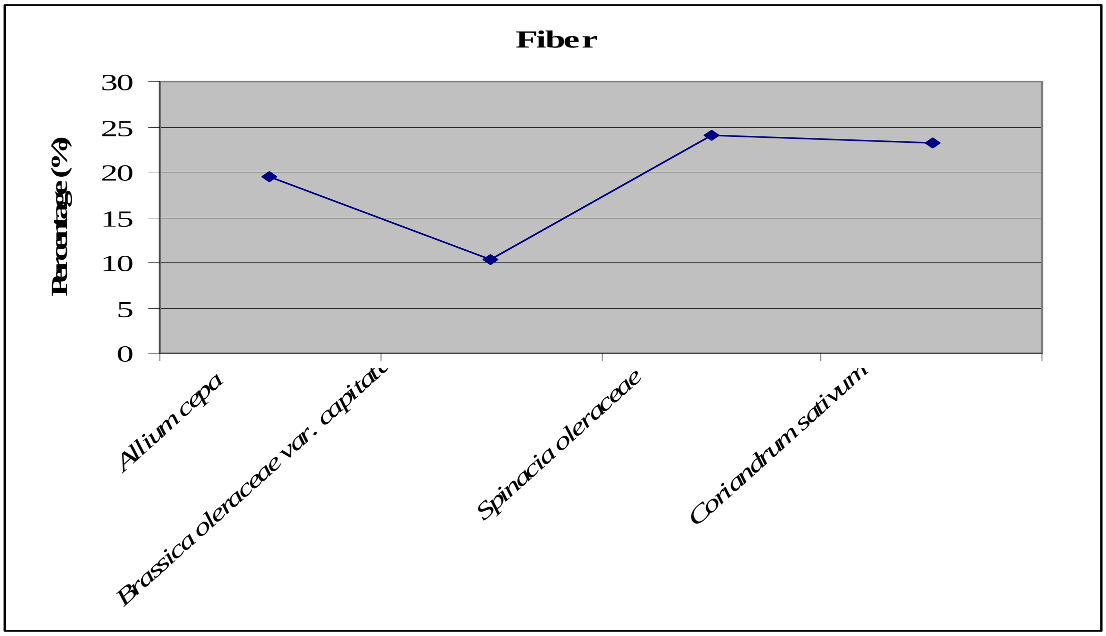

Fig. 4. Crude fiber content of the wild vegetables analyzed.

3.2. Protein, fat, carbohydrate and energy contents

Protein content for the four selected vegetable species *Allium cepa*, *Brassica oleraceae var. capitata*, *Spinacia oleraceae* and *Coriandrum sativum* were: 5.01, 9.59, 17.29 and 18.356 (%), respectively (Table 3).

Table 3. Lipid, protein, carbohydrate and crude energy contents of the vegetable species analyzed

Species name	Lipid (%)	Protein (%)	Carbohydrate (%)	Energy (kCal/100 g)
Allium cepa	11.15 ± 0.02^{d}	5.01 ± 0.01^{a}	49.81 ± 0.07^{b}	319.77 ± 0.39^{c}
Brassica oleraceae var. capitata	2.02 ± 0.01^{c}	9.59 ± 0.04^{b}	56.18 ± 0.15^{c}	281.23 ± 0.50^{b}
Spinacia oleraceae	1.12 ± 0.001^{a}	17.29 ± 0.01^{c}	44.58 ± 0.10^{a}	257.51 ± 0.41^{a}
Coriandrum sativum	1.43 ± 0.01^{b}	18.36 ± 0.04^{d}	49.65 ± 0.06^{b}	284.87 ± 0.22^{b}

^{abcd} Values are mean ± standard deviations of three (n = 3) measurements. Different superscript letters within columns are significantly different ($p < 0.05$).

Protein gives 4.0 kCal energy for 1g sample. *Coriandrum sativum* was having highest protein content thus making it comparatively a good food (Fig. 5). This value was higher compared to 2.11 % in *Amaranthus viridus,* 2.98 % in *Chenopodium murale* leaves and 2.76 % in *Nasturitium officinale*, (Imran et al., 2007). The protein content was also higher than medicinal plants including *Ranunculus arvensis*, *Equisetum ravens*, *Carathamus lanatus* and *Fagonia critica* as explained by Hussain et al., (2011).

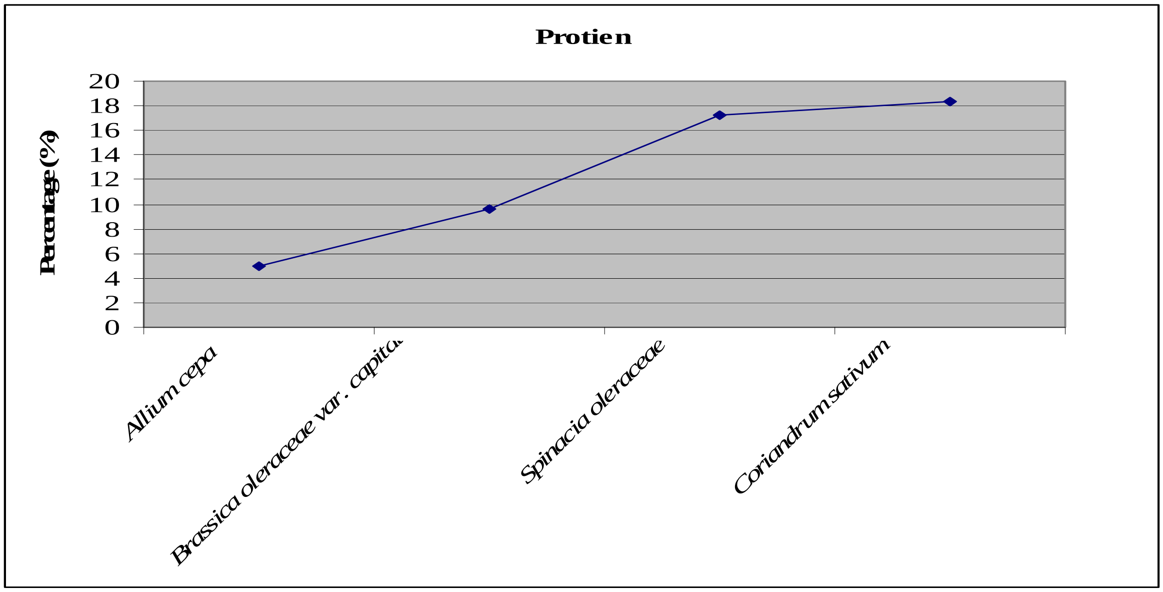

Fig. 5. Protein content of wild vegetable species.

Lipids are very important from the nutritional point of view because 1 g of the lipid give 9 kcal energy. The lipid contents of four analyzed vegetables were as shown in Table 3.

Allium cepa, *Brassica oleraceae var. capitata, Spinacia oleraceae* and *Coriandrum sativum* showed 11.151, 2.016, 1.118 and 1.428 (%) lipid contents respectively (Table 3). It was observed that *Allium cepa.* is having the highest lipid contents and thus making it an energy rich source food, compared to others (Fig. 6). It is lower than 28.2 % in *Centilla asiatica* leaves and 29 % in *Bahunian purpurea* leaves, 60 % in *Amaranthus hybridus*, but high than 0.47 % in *Amaranthus viridus*, 0.54 % in *Chenopodium murale* and 0.63 % in *Scandex pectenveneris* leaves (Imran et al., 2007).

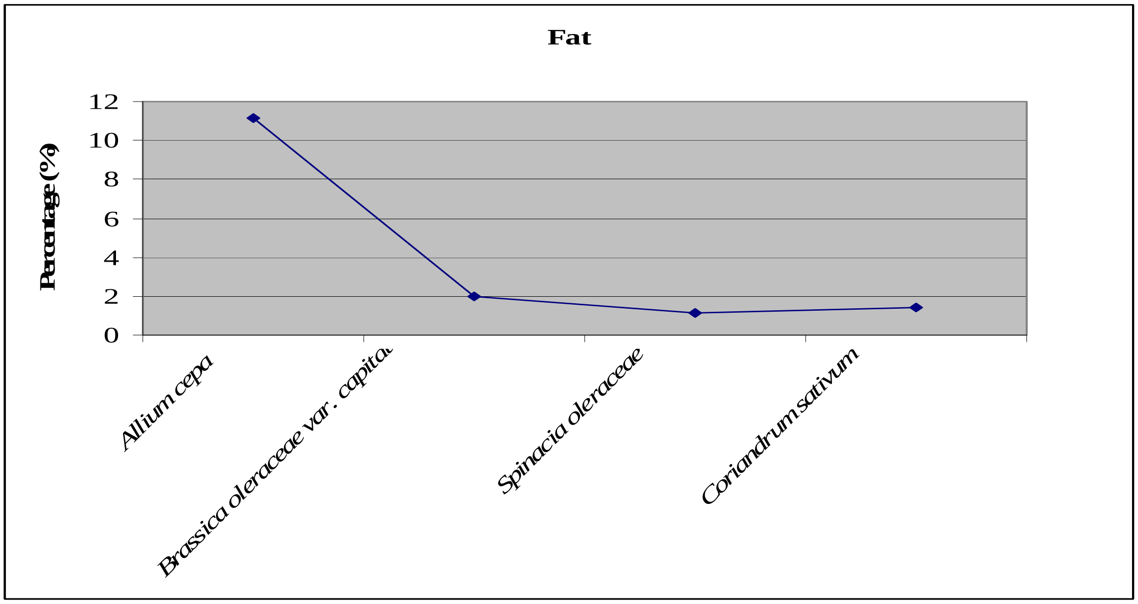

Fig. 6. Lipid content of the wild vegetable species analyzed.

Carbohydrate is the primary source of energy in the body. The 1 g of carbohydrates yields 4 kCal energy. The carbohydrates content of, *Allium cepa*, *Brassica oleraceae var. capitata*, *Spinacia oleraceae* and *Coriandrum sativum* were: 49.81, 56.179, 44.576 and 49.649 (%) respectively (Table 3). *Brassica oleraceae var. capitata* was having highest carbohydrates contents (56.179%) as shown Fig. 7. It was lower ompared to other wild edible plants such as *Amaranthus caudatus* leaves (61.03 %), 75 % in sweet potato leaves, 82.8 % in *Corchorus triden* leaves. But higher than *Amaranthus viridus ,Chenopodium murale, Nastritium officinale* and *Scandex pectenveneris* leaves that is 4.74, 3.41, 3.38 and 7.32 % respectively (Imran et al., 2007). Carbohydrates are principal and indispensible source of energy. The RDA for carbohydrates is 130 g (FAO 1998), while in Pakistan 349 g of carbohydrate intake is reported (Ministry of Health and Nutrition 1994). Due to carbohydrates content sample plant can be a good food source.

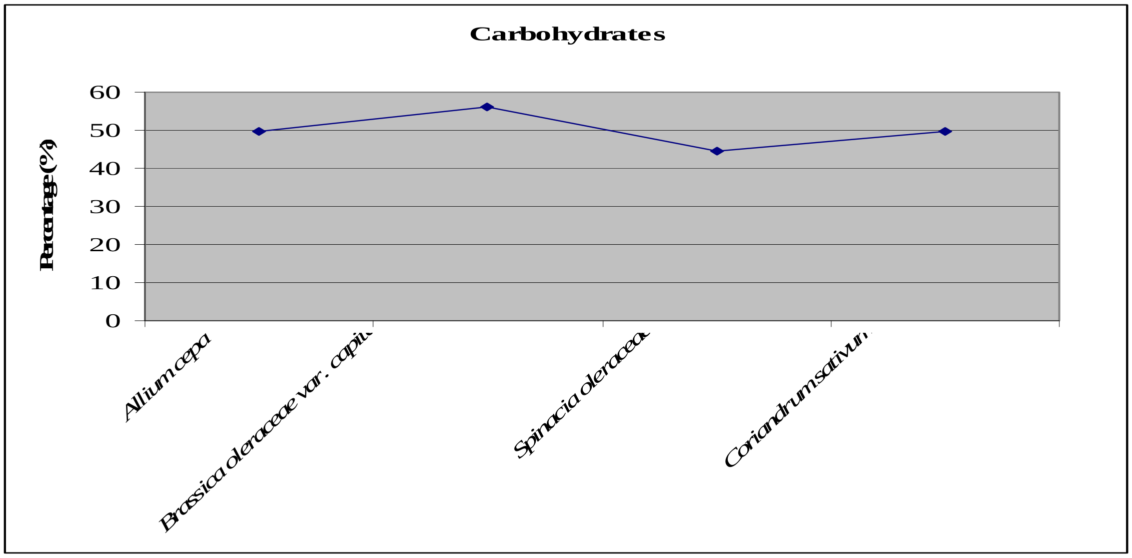

Fig. 7. Carbohydrate contents of the wild vegetable species.

The overall calculated energy values of the analyzed vegetables were as given in Table 3. *Allium cepa* was having the highest energy value (319.77 kcal / 100 g) as shown in the Fig. 8. The caloric value was high compared to *Amaranthus viridus* (31.63 kCal), *Scandex pectenveneris* (50.23 kcal), but lower when compared to *Amaranthus caudatus* 326.7 Kcal, and 333.1 kcal of *Ficus bengalensis* (Imran et al., 2007).

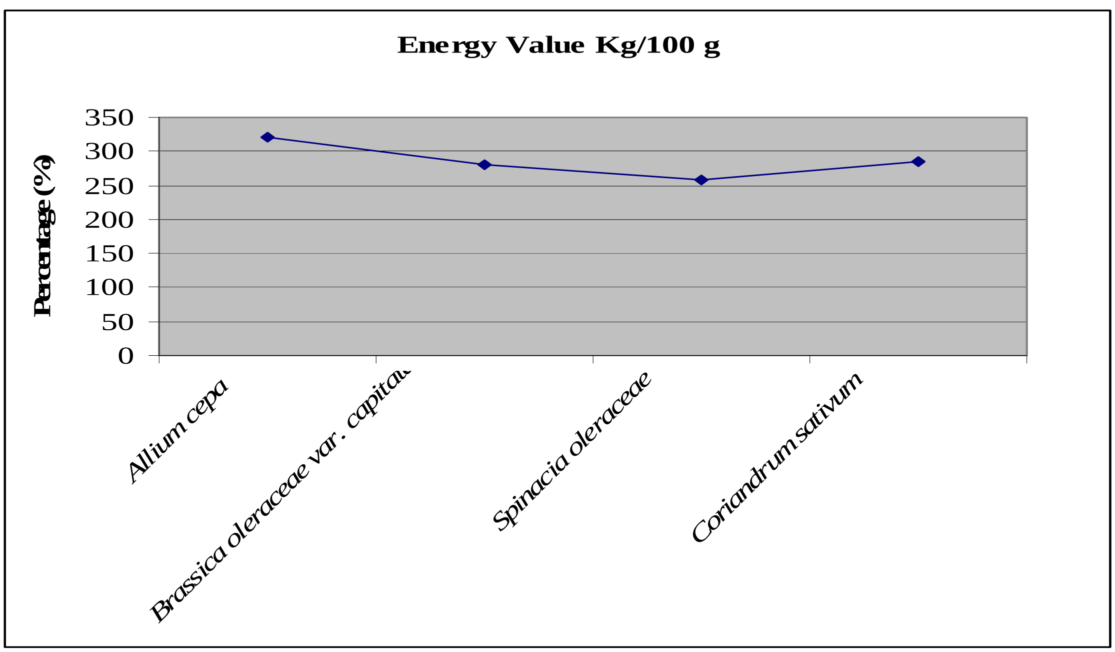

Fig. 8. Energy values of the wild vegetable species.

4. Conclusions

The four wild vegetable species, *Allium cepa*, *Brassica oleraceae var. capitata, Spinacia oleraceae,* and *Coriandrum sativum* were proved to be ladled with appreciable levels of proximate parameters of carbohydrate, proteins, lipids and fiber. Their calculated energy values were also comparable to other well know vegetables. Thus these wild vegetables may be considered as a good source of food.

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